ORF 455 & 555, Fall 2025: Homework 4

due by Friday 11/14 at 11:59pm. Please upload to Gradescope

For this assignment, you can work in groups of up to 3 people. Please make sure to list the names of those in your group.

1. The data files contain daily closing prices (over the past 6 years) listed on the CME associated to the 5 commodities oil, wheat, natural gas, copper and silver. These are in fact futures prices for the next contract, but let us view them as the commodity "spot" price. Also given are the S&P 500 index and Bitcoin (BTC) price over the same period.

   The goal is to compute estimates of the pairwise correlations between the returns, and to see if there is more (or less) correlation before and during the Russian invasion of Ukraine that began in February 2022. Call **period 1** the time from 5/9/19 through 2/20/22, and **period 2** the time from 2/21/22 through 11/4/25.

   (a) **Commodity-commodity correlations**
   Take the 5 commodity time series and transform the data into a time series of *daily returns*.
   i. Give a matrix of the annualized correlations between the returns of each pair of the 5 commodities using only the data from period 1.
   ii. Give a matrix of the annualized correlations between the returns of each pair of the 5 commodities using only the data from period 2.
   iii. Comment if the correlation matrix has changed (measured relatively) in any significant way between the two periods, and suggest an explanation to what you observe.

   (b) **Commodity-equity correlations (financialization)**
   Take the S&P500 time series and transform the data into a time series of *daily returns*.
   i. Give a table of the annualized correlations between the returns of each of the 5 commodities and the returns of the S&P500 using only the data from period 1.
   ii. Give a table of the annualized correlations between the returns of each of the 5 commodities and the returns of the S&P500 using only the data from period 2.
   iii. Comment if the extent of financialization of commodity markets has changed in any significant way between the two periods, and suggest an explanation to what you observe.

   (c) **Bitcoin**
   Take the Bitcoin time series and transform the data into a time series of *daily returns*.
   i. Give a table of the annualized correlations between the returns of each of the 5 commodities plus the S&P500 and the returns of BTC using only the data from period 1.
   ii. Give a table of the annualized correlations between the returns of each of the 5 commodities plus the S&P500 and the returns of BTC using only the data from period 2.
   iii. Is Bitcoin a commodity or a currency and has that changed over the past 5 years?

2. See the associated Jupyter notebook file.

3. See the associated Jupyter notebook file.

4. Download electricity supply bids from the NYISO webpage for the following days in 2025: June 23,24 and June 16,17. Specifically, use the corresponding Gen Bids files from `https://mis.nyiso.com/public/P-27list.htm` Also take the ISO load forecasts for those days from `https://mis.nyiso.com/public/P-7list.htm` You can also view the fuel mix and prices in real time during those days, as well as percentage renewables use and actual demand, at, for instance `https://www.gridstatus.io/live/nyiso?date=2025-01-23`

(a) Construct the bid stacks from the data for 8am, 12pm, 5pm, 6pm, 7pm, 8pm for each day. Plot them (on separate price vs. electricity quantity graph) and intersect it with a vertical line at the forecasted demand level to find the day ahead clearing price. They should look something like You should use the DAM bids, and assume they form a step function (opposed

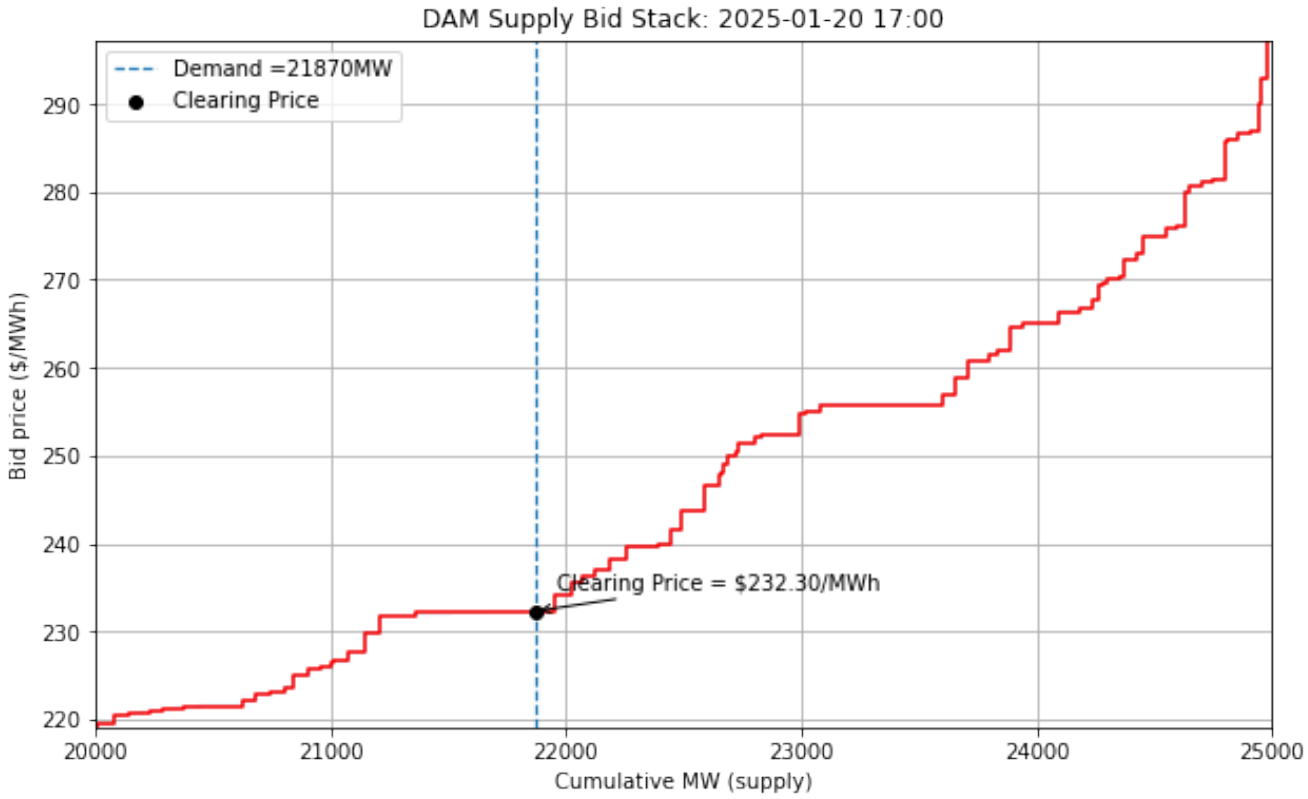

Figure 1: January 20th, 2025, hour 17.

to drawing and line connecting the points).

(b) On June 23 and 24, the eastern US was in the middle of a major heatwave and there were concerns leading up to those days as to whether the NY and PJM grids would be able to handle the load. What does the bid stack and fuel mix data tell you about "what happened" on the NY grid during the heatwave days, and contrast with the Monday and Tuesday of the previous week. In particular, touch on price spikes, for instance in the early evening hours, and comment on what you think the data implies "caused" them. Plot the DART (which I will here define as real time minus day ahead prices) through the 4 days. This is an open-ended question – give a brief narrative supported by references to these and any other plots that are helpful. There is no right answer, but plenty of wrong ones.